Chapter 2. Alternatives

This chapter describes the process used to develop alternatives to the Proposed Action, similarities among the alternatives, a detailed description of each alternative, and a summary comparison of the alternatives by each of the primary components.

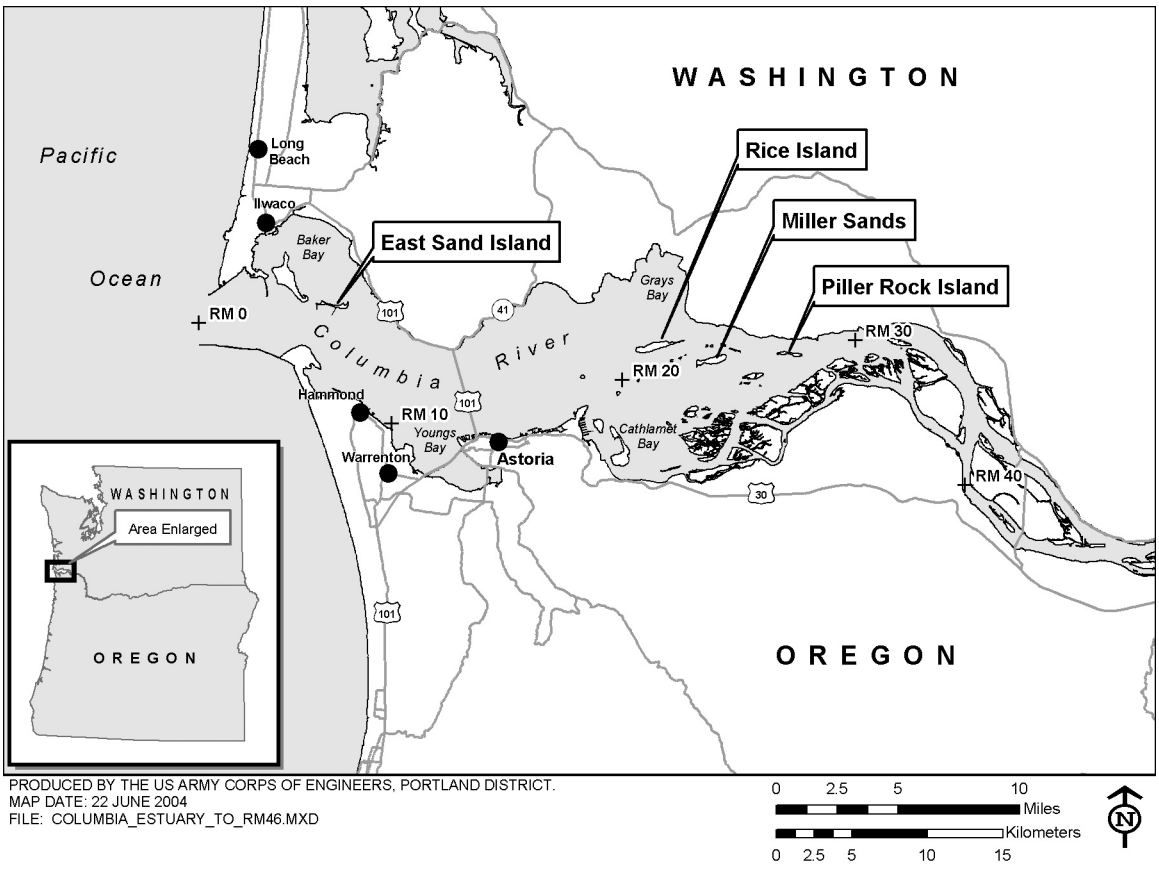
2.1 Alternative Development

The National Environmental Policy Act (NEPA) requires Federal agencies to evaluate a full range of reasonable alternatives to a Proposed Action. The alternatives should meet the purpose and need of the proposal while minimizing or avoiding detrimental environmental effects. The NEPA alternative development process allows the Service, Corps, and NOAA Fisheries to work with the public, stakeholders, interested agencies, and Tribes to formulate alternatives that respond to the issues identified during the scoping process. This DEIS documents the planning and decision-making process.

2.1.1 Rationale for Alternative Design

All alternatives considered were evaluated in relation to their ability to reduce tern predation on ESA-listed Columbia River salmonids while ensuring the conservation of terns in the Pacific Coast region. NEPA regulations require the analysis of a No Action alternative (Alternative A). The settlement agreement also required the analysis of a No Management alternative (Alternative B). The remaining alternatives were developed after evaluating comments received during the public scoping period, holding interagency meetings and internal discussions, and reviewing the best available scientific information. The effects of each alternative described below are analyzed in detail in Chapter 4, Environmental Consequences.

FIGURE 2.1. Columbia River Estuary (mouth to RM 46)]



2.2 Similarities Among Alternatives

Although the alternatives differ in many ways, there are similarities (i.e., shared features or management components) among them as well. These similarities are listed below to reduce the length and redundancy of the individual alternative descriptions. The following is a description of features common to all alternatives (Alternative A through D).

Prevent tern nesting in the upper estuary. The Corps would continue efforts to prevent Caspian tern nesting on upper estuary islands (e.g., Rice Island, Miller Sands Spit, Pillar Rock Island, see Figure 2.1) of the Columbia River estuary to prevent high predation rates of juvenile salmonids and comply with the 1999 Corps Columbia River Channel Operation and Maintenance Program Biological Opinion. Management actions, as appropriate, may include repeated hazing of adult terns on islands from April 1 to June 15 to prevent colony establishment, nesting habitat modification through establishment of vegetation, or other measures (e.g., installation of silt fencing, see photo below). Hazing would consist of personnel or dogs directly disturbing terns that aggregate on upland habitat suitable for nesting purposes. Personnel may use all terrain vehicles for ease of access and to cover distances involved at these upper estuary islands. Eagle silhouette decoys and/or kites may also be employed to preclude nesting terns. Terns that aggregate (e.g., roosting, resting) below the high tide line would not be disturbed. Personnel involved in hazing are restricted in their movements and presence to the tern nesting area, and are to remain out of vegetated areas that support other wildlife resources to the extent practicable.

Permit egg take from upper estuary islands. Should early season hazing activities fail to prevent tern nesting, the Service would issue an egg take permit to the Corps for upper estuary islands (does not include East Sand Island). This permit would assist in preventing the establishment of new tern colonies in the upper Columbia River estuary.

Tern colony on Rice Island (2000) with silt fencing used to prevent terns from nesting on portions of the former colony site. Photo Credit: Tim Jewett

Resumption of dredged material disposal on Rice Island. Since the shift of the Columbia River estuary tern colony from Rice Island to East Sand Island, this former colony location is overgrown with vegetation. Terns no longer attempt to nest at this location. The Corps will resume dredged material disposal on the downstream end of Rice Island, the former location of nesting terns.

The Columbia River estuary, referred to immediately above, pertains to the river downstream of river mile 46 or approximately, the upstream end of Puget Island (Figure 2.1).

2.3 Detailed Description of Alternatives

2.3.1 Alternative A - No Action (Current Management Program)

This alternative assumes no change from the current management program and is considered the baseline from which to compare the other alternatives. Under this alternative, approximately 6 acres of nesting habitat would be maintained annually for terns on East Sand Island. This requires annual maintenance in order to provide proper nesting habitat conditions: a bare sand substrate free of vegetative cover.

To attain the proper habitat conditions on the 6-acre site, equipment is barged to the site during the last week of March or first week of April. Habitat management at this time allows terns to establish nests on the site before the reestablishment of vegetative cover from grasses and forbs. Typically, a tractor and disc are used to till the site, turning under herbaceous vegetation. This is generally followed by running a heavy drag harrow over the site to smooth the surface. Periodically, additional sand is placed on the nesting site to fill erosion channels and low elevation spots as wind and water erosion remove sandy material from the site each year. Sand replenishment in 2003 was accomplished by borrowing sand from the upper beach on the east end of East Sand Island using a tracked excavator and a 25 cubic yard capacity off-road dump truck. This beach is the most likely source for borrowing sand material in the future.

In September or October, herbicide (Rodeo) may be applied to European beachgrass and American dunegrass to control their presence on the tern

nesting site. Tillage operations result in the spread of these plants over the nesting site. Herbicide is sprayed in a spot application manner with denser stands receiving a broadcast spray. Equipment and water for herbicide dilution are transported to the site via boat.

Habitat enhancement on East Sand Island. Photo Credit: Columbia Bird Reserch (OSU/RTR)

2.3.2 Alternative B – No Management

The Settlement Agreement requires analysis of this alternative in the EIS. Under this alternative, no management actions would occur on East Sand Island. The current tern nesting area would most likely become vegetated within 3 to 5 years post-implementation of this alternative (similar to that observed in 1985 and 1986 after the last dredged material was deposited), resulting in the loss of the tern nesting site. Thus, abandonment of this colony on East Sand Island would most likely occur. Hazing efforts and possibly egg take would be implemented, as in all alternatives, to prevent tern nesting at upper estuary islands. See section 2.2 for more details on these actions.

2.3.3 Alternative C –Redistribution of East Sand Island Tern Colony - PREFERRED ALTERNATIVE

Under this alternative, tern nesting habitat and colony size on East Sand Island would be reduced to approximately 1 to 1.5 acres and a segment of the concentrated tern colony in the estuary would be redistributed to other nesting sites within the Pacific Coast region. This redistribution would be achieved by ensuring that a network of sites with suitable nesting habitat is available to displaced terns within the region. We propose to manage nesting habitat for terns in the region to replace twice the amount of nesting habitat that would be lost on East Sand Island.

Terns have nested on an average of 4.3 acres (range of 3.9 to 4.5) on East Sand Island from 2001 to 2003 (Collis et al. 2002a, 2003b). Reduction of the nesting area to 1 to 1.5 acres would require a minimum of 6 to 7 acres of replacement habitat in the region. We propose to manage approximately 8 acres at alternate sites for terns (see below). The remaining 1 to 1.5 acres on East Sand Island would be managed to maintain suitable tern nesting habitat in the Columbia River estuary to support approximately 2,500 to 3,125 breeding pairs. This colony size exceeds those typical of the Pacific Coast region as well as the first colony that nested on East Sand Island in 1984 (approximately 1,200 breeding pairs).

The proposed reduction in habitat on East Sand Island would occur only after alternate nesting habitat is enhanced elsewhere in the region and is available to terns displaced from East Sand Island. Thus, habitat enhancement in the region and reduction in habitat on East Sand Island would be phased in at a 2:1 ratio. For example, if 2 acres of nesting habitat is enhanced for terns outside of the Columbia River estuary (i.e., in 2005), the tern nesting area on East Sand Island would be reduced by 1 acre in the following year (i.e., in 2006). The approximately 8 acres of managed habitat that would be enhanced in the region would be selected from the list of sites located in Table 2.1. Habitat alteration and enhancement would occur at most of these sites. Additional proposed management actions include management of predator or human disturbance and social facilitation (e.g., decoys, vocalizations, etc.).

The proposed habitat acreage (approximately 1 to 1.5 acres) on East Sand Island is expected to be reached in 3 to 5 years, depending upon available funding for habitat enhancement elsewhere in the region. The size of the tern nesting site at East Sand Island (acreage) would be determined annually, and would be dependent upon how much acreage of alternate habitat has been created to date elsewhere in the region. Habitat reduction on East Sand Island would be attained by allowing vegetation to grow in the current nesting area and the remaining tern nesting site would be cleared via the methods described above in Alternative A. After the proposed acreage on East Sand Island has been attained, annual maintenance would continue to clear the nesting site on East Sand Island using methods similar to those described in Alternative A, with a management area of 1 to 1.5 acres instead of 6 acres.

This proposed habitat acreage on East Sand Island was selected to reduce tern predation in the estuary on juvenile salmonids to a level that would increase salmonid population growth rates (lambda, λ). Populations with a positive growth rate ($\lambda > 1$)

TABLE 2.1 Potential Caspian tern nesting sites and proposed management actions associated with Alternatives C and D. Sites are listed in geographical order from north to south[a].

Site Name	Proposed Management Action	Projected Available Acreage
WASHINGTON		
Dungeness NWR, Clallam County	Signs for area closure and monitor predator activities	1+ acres
OREGON		
Crump Lake, Lake County	Enlarge and stabilize Crump Island at an elevation to prevent flooding; social facilitation	1 acres
Summer Lake Wildlife Area, Lake County	Create three half acre islands in the East Link impoundment, and near Windbreak and Gold dikes; social facilitation	1.5 acres
Fern Ridge Lake, Lane County	Construct one island north of Royal Avenue near Gibson Island; social facilitation	1 acre
CALIFORNIA		
Brooks Island, Central San Francisco Bay, Contra Costa County	Remove exotic vegetation; predator control; gull harassment or control; protect shoreline; public use management and outreach.	2 acres
Hayward Regional Shoreline, Alameda County	Substrate enhancement; social facilitation; predator control; gull harassment or control	0.5 acre
Ponds N1/N9, Don Edwards, San Francisco Bay NWR, Alameda County	Substrate enhancement; social facilitation; predator control; gull harassment or control	0.5 - 1 acre

[a] See Table G.4 for list of sites elimited from management consideration.

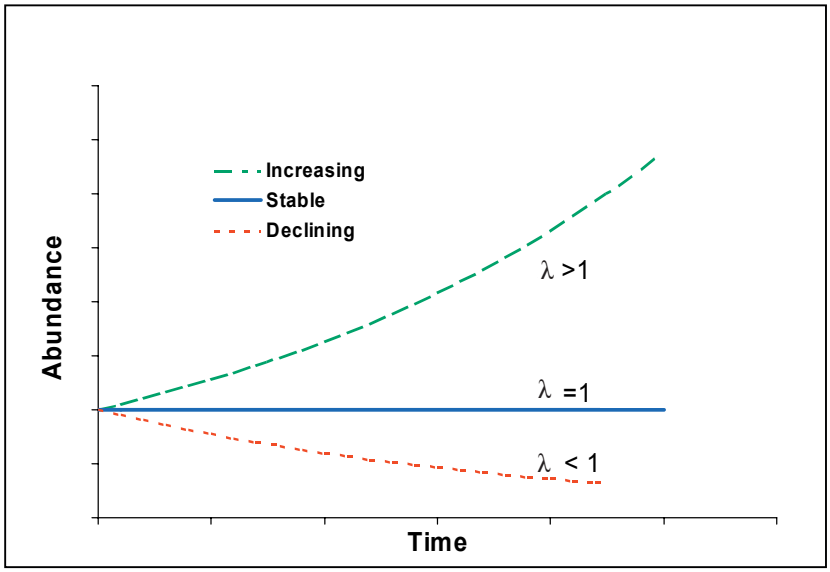
increase in number and thus, would aid salmon recovery (Caughley 1994 and McClure et al. 2003, Figure 2.2).

In determining an acceptable predation level by terns, NOAA Fisheries conducted an analysis using a life cycle model and tern predation rates to estimate the impact of tern predation on the population growth rate of various Evolutionary Significant Units (ESUs, see Chapter 3, section 3.2.3 for definition) of Columbia River Basin steelhead (NOAA Fisheries 2004, Appendix C). Steelhead were the focus of this analysis because they are consumed in the highest numbers by terns, and thus, are most affected by tern predation in the Columbia River estuary. Estimates of the potential benefits of reducing tern predation are the greatest for steelhead but other salmonids consumed by terns would also benefit. Additionally, ESU-specific analysis was conducted because NOAA Fisheries manages Columbia River steelhead at the individual ESU level.

The analysis compared the use of Passive Integrated Transponder (PIT) tag and bioenergetics modeling data sets as sources to calculate an estimated tern predation rate and percent increase in salmon population growth. PIT-tags are small tags inserted into the juvenile fish's body cavity which can be used to determine the location and status (e.g., live or dead) of tagged fish. Identifying PIT-tags on tern colonies can provide a minimum estimate of the proportion of stocks that are consumed by terns at any particular colony. Bioenergetics models are used to estimate consumption levels of piscivorous birds by calculating the amount of prey consumed in biomass or numbers based on diet composition, energy content of prey, energy requirements of individual consumers (i.e., terns), and the number of individual consumers present. Both PIT-tag and bioenergetics modeling analyses demonstrated that the percent increase in population growth rate (λ) is improved as the number of tern pairs are reduced on East Sand Island (NOAA Fisheries 2004, Appendix C). However, the analysis also demonstrated that predation rates are not uniform for all salmon species, thus, analysis of individual ESU-specific predation rates was necessary. Only PIT-tag data was suitable for analyzing benefits to individual steelhead ESUs.

The NOAA Fisheries analysis estimated that a reduction in the tern colony to approximately 3,125 nesting pairs would result in a 1 percent or greater increase in population growth rate (recommended by NOAA Fisheries) for four Columbia River Basin steelhead ESUs (Table 2.2 or Table 5 in Appendix C). However, predation rates based on PIT-tag recovery data are considered minimal because detection efficiency is not 100 percent as not all tags are deposited on nesting islands (e.g., some PIT-tags are most probably excreted over water, removed by wind and water erosion, or damaged and undetectable). Thus, we propose managing a more conservative range of nesting pairs (approximately 2,500 to 3,125) on East Sand Island to ensure an increase in population growth rate for each of the four Columbia River Basin steelhead ESUs. Based on average nesting densities observed on East Sand

FIGURE 2.2. Illustration of increasing, stable, or declining population growth rates (λ)



(average of 0.55 nesting pairs per square meter, Collis et al. 2003b, Roby pers. comm.) and Rice islands (peak of 0.78 nesting pairs per square meter, Roby et al. 2002), this proposed range of nesting terns would be able to nest on the 1 to 1.5 acres, as proposed in this alternative.

Other factors were considered in determining the proposed habitat acreage on East Sand Island, including the average size of coastal tern colonies (e.g. 55 to 1675 nesting pairs) and social behavior necessary for terns to nest successfully. The proposed range of nesting pairs on East Sand Island in this alternative (2,500 to 3,125 pairs) is substantially above the individual average colony sizes typically found along the Pacific Coast (Table F.2). This number also exceeds the size of the tern colony that historically colonized East Sand Island in 1984 (approximately 1,200 pairs). The proposed acreage and anticipated colony size should be suitable to avoid colony abandonment on East Sand Island due to an insufficient number of breeding pairs and encourage the social stimulus to breed.

TABLE 2.2. Population growth rate (λ) and estimated percent increase in four listed steelhead ESUs in the Columbia River Basin given a range of Caspian tern nesting pairs on East Sand Island (taken from NOAA Fisheries 2004, Appendix C).

	Snake River ESU		Upper Columbia River ESU		Middle Columbia River ESU		Lower Columbia River ESU	
No. of Tern Nesting Pairs	**% Δ λ**	**λ**	**% Δ λ**	**λ**	**% Δ λ**	**λ**	**% Δ λ**	**λ**
10000	0.000	1.020	0.000	1.000	0.000	0.970	0.000	0.920
9375	0.124	1.021	0.323	1.003	0.123	0.971	0.100	0.921
8750	0.248	1.023	0.644	1.006	0.245	0.972	0.200	0.922
8125	0.371	1.024	0.962	1.010	0.366	0.974	0.299	0.923
7500	0.494	1.025	1.277	1.013	0.487	0.975	0.398	0.924
6875	0.616	1.026	1.589	1.016	0.608	0.976	0.497	0.925
6250	0.738	1.028	1.898	1.019	0.728	0.977	0.595	0.926
5625	0.859	1.029	2.205	1.022	0.847	0.978	0.693	0.926
5000	0.979	1.030	2.510	1.025	0.966	0.979	0.791	0.927
4375	1.099	1.031	2.812	1.028	1.084	0.981	0.888	0.928
3750	1.219	1.032	3.112	1.031	1.202	0.982	0.985	0.929
3125	**1.337**	1.034	**3.409**	1.034	**1.319**	0.983	**1.082**	0.930
2500	1.456	1.035	3.704	1.037	1.436	0.984	1.178	0.931
1875	1.574	1.036	3.996	1.040	1.552	0.985	1.274	0.932
1250	1.691	1.037	4.287	1.043	1.668	0.986	1.370	0.933
625	1.808	1.038	4.575	1.046	1.783	0.987	1.465	0.934
0	1.924	1.040	4.861	1.049	1.898	0.988	1.560	0.934

% Δ λ = percent change in population growth rate (λ)
λ = population growth rate

Although we have identified a proposed acreage (approximately 1 to 1.5 acres) on East Sand Island, the tern nesting area would be managed based on how terns respond to the reduction in habitat. For example, if a number of terns above the proposed range of nesting pairs continue to attempt nesting on East Sand Island, the proposed habitat acreage would be reduced (potentially to less than 1 acre) in the subsequent year to decrease the number of nesting terns to within the proposed range (2,500 to 3,125 nesting pairs).

Based upon the average number of nesting pairs (approximately 9,070) in the Columbia River estuary from 2000 to 2003 (Collis et al. 2002a, 2003a, and 2003b), approximately 5,945 to 6,570 breeding pairs of Caspian terns would be displaced from nesting on East Sand Island with implementation of this alternative. To minimize any possible negative effect to the Pacific Coast regional tern population by this action and to encourage redistribution of terns within the region, this alternative also identifies habitat that could be enhanced or developed for displaced terns. Although some nesting habitat is currently available for displaced terns at various sites within the Pacific Coast region (Appendix F, Table F.1 and Table F.2), this alternative ensures a network of sites with suitable nesting habitat for terns by managing up to seven sites distributed among both coastal and interior habitats specifically for nesting terns. Approximately 8 acres of nesting habitat would be selected from various sites in Washington, Oregon, and California (Table 2.1). See Appendix G for more detail regarding selection of sites and management actions required at each site for preparation of tern nesting habitat.

2.3.4 Alternative D – Redistribution and Lethal Control of East Sand Island Tern Colony

Similar to Alternative C, tern nesting habitat and colony size on East Sand Island proposed in this alternative would be reduced to decrease tern predation on juvenile salmonids and encourage redistribution of the large concentrated tern colony to other nesting sites within the Pacific Coast region. As with Alternative C, the proposed habitat acreage (approximately 1 to 1.5 acres) and anticipated number of nesting terns was selected to increase the population growth rate (λ) for four Columbia River Basin steelhead ESUs by at least 1 percent (Table 2.2, NOAA Fisheries 2004, Appendix C). Also similar to Alternative C, approximately 8 acres from sites within the Pacific Coast region would be managed as potential Caspian tern nesting sites to replace the habitat lost on East Sand Island and ensure a network of suitable nesting habitat is available to displaced terns. Sites would be selected from the same seven sites identified in Alternative C (Table 2.1). Reduction in tern nesting habitat on East Sand Island would be phased in as habitat at alternate sites are developed at a 2:1 ratio (see description in Alternative C). Similar to Alternative C, we expect the tern nesting area would be reduced to 1 to 1.5 acres within 3 to 5 years, depending upon available funding for habitat enhancement elsewhere in the region.

The East Sand Island tern colony may respond to habitat reduction efforts by compressing into the smaller acreage (at a higher nesting density). Thus, the above management actions could fail to disperse majority of the tern colony. Unlike Alternative C, this alternative proposes to implement a lethal control program if habitat reduction on East Sand Island, combined with development of potential nesting habitat, is not sufficient to reduce the colony size by 2008. The lethal control program would attempt to achieve the proposed range of nesting terns (approximately 2,500 to 3,125 pairs) by killing up to 50 percent of breeding adult terns each year. Methods for killing adults would consist of euthanasia of terns after capturing them with a rocket net or the use of shotguns. Carcasses would be collected and provided to research facilities or museums. Any unused carcasses would be burned or buried off-site.

The actual number of terns that would be killed under this alternative would depend on the success of redistributing majority of the colony to other sites in the region. If the entire colony compressed into the smaller acreage that would remain on East Sand Island, a substantial number of terns would need to be killed. If the colony was partially reduced (e.g., 50 percent) through habitat reduction, we can use a tern population model to project the number of terns that could potentially be killed (e.g., 1,000 to 6,000 terns every year in the first 5 years, see section 4.2.1.4). Lethal control would most likely need to continue annually to keep the number of terns within the proposed range. An egg oiling or removal program was considered in this alternative as a means to decrease the tern colony size. However, population modeling and a literature review demonstrated that an egg oiling or removal program only reduces productivity of the tern colony and thus, would not be effective in reducing the number of adult terns in a reasonable timeframe (Blackwell et al. 2000, Belant 1997, Christens and Blokpoel 1991, Seubert 1990).

2.4 Monitoring and Adaptive Management Plan

A monitoring program for the preferred alternative identified in this DEIS would be three-fold:

1. Long-term monitoring of the regional Caspian tern population and the network of suitable nesting habitat within the region. Monitoring of colony sizes for all colonies in the region would occur immediately following management actions and conclude 3 years after the proposed habitat acreage on ESI has been attained. Following this period, monitoring of the regional population would occur every 10 years (as recommended by Shuford and Craig (2002) in the Caspian Tern Status Assessment). Additionally a selected subset of breeding sites would be regularly surveyed every 2 to 3 years to track more closely the regional population trend;

2. Short-term monitoring of the East Sand Island colony (i.e, colony size and reproductive success) to determine the response of terns to the reduction of habitat (to be completed 3 years after the proposed habitat acreage and number of nesting pairs has been attained); and

3. Short-term monitoring of the presence, absence, and colony size at managed alternate sites. Monitoring efforts would initiate immediately following management actions at each site and conclude 3 years after the proposed habitat acreage is attained on East Sand Island. Monitoring and research of tern diet and reproductive success at managed alternate sites would also be initiated when the colony size at each site reaches an identified minimum threshold (e.g., 500 pairs) that will be identified during the development of the monitoring and adaptive management plan.

The intent of the monitoring program is to determine the level of success and impacts associated with management actions. Monitoring after implementation of the preferred alternative would also allow for an adaptive management approach (e.g., altering management actions if response does not meet specified objectives). Specific details of the monitoring program will be described in a monitoring and adaptive management plan that will be developed upon completion of the EIS and selection of a proposed action.

2.5 Alternatives Considered but Eliminated from Detailed Study

The alternative development process under NEPA is designed to allow consideration of the widest possible range of issues and potential management approaches. During the alternative development process, many different solutions were considered. The following alternatives were considered but not selected for detailed study in this DEIS for the reason(s) described below.

2.5.1 Elimination of Caspian Terns from East Sand Island

This alternative would actively eliminate all nesting habitat for terns on East Sand Island, thus displacing the entire nesting colony. The open and sandy habitat would be eliminated by actively seeding the site and allowing the vegetation to grow into tall and dense cover, thus precluding terns from East Sand Island. In addition, hazing of adult terns would be conducted. This alternative was not acceptable since it would violate Guiding Principle number 3: "…ensure Caspian terns remain a viable and integral part of the estuarine, coastal, and interior ecosystems of the Pacific Coast region, including the Columbia River estuary…"

2.5.2 Maximum Redistribution of Terns throughout the Region

This alternative would reduce habitat on East Sand Island for terns to 1 to 1.5 acres and actively facilitate the redistribution of displaced terns to sites in Washington, Oregon, and California. The initial review (feasibility assessment) of potential tern nesting sites conducted in 2002 and scoping for this DEIS identified six sites in Washington, three sites in Oregon, and three sites in California for Caspian tern management. These sites met all of the criteria used in the feasibility assessment (Seto et al. 2003) and this DEIS (see Appendix G).

Washington sites identified with potential for tern management are located in Grays Harbor, Padilla Bay, and Jetty Island (Puget Sound). Historic colonies in Grays Harbor constituted one of the larger coastal colonies in the region (peak number of 3,590 pairs in 1987, Shuford and Craig 2002) before loss of nesting habitat, gull predation, and bald eagle disturbance apparently caused terns to abandon the site (Shuford and Craig 2002, Seto et al. 2003). Terns last nested in the harbor in 1989. Currently, adults are observed feeding and roosting on the remaining four islands in the harbor throughout the breeding and post-breeding months (Seto et al. 2003). Numbers remain below 50 terns during the

breeding months but can increase to over 100 during the post-breeding months, including recently fledged chicks (Seto et al. 2003, Columbia Bird Research 2003). Three of the four islands in Grays Harbor are owned and managed by the Department of Natural Resources, one of which is managed as a Natural Area Preserve. Goose Island, one of the historic tern nesting sites, was designated as a Natural Area Preserve specifically to protect nesting Caspian terns. This island is now under water. The remaining three islands, have limited human and mammalian predator access and would require moderate habitat enhancement to create open nesting habitat for terns. The fourth island, "Cate Island", would also require moderate habitat enhancement. Since this island has mixed private and public ownership and is closer to the mainland, the potential for human disturbance and mammalian predator access is more likely.

Padilla Bay, in northern Puget Sound, contains four dredge spoil islands along the Swinomish channel. Caspian terns (peak number of 126 pairs in 1995) historically nested on a small, privately-owned island in the 1990s but in recent years only a small number of non-breeding adults have been observed (M. Davidson, pers. comm.). This island is small and dynamic, providing little management potential for habitat enhancement. However, the Washington Department of Fish and Wildlife (WDFW) is currently considering creating larger islands in the bay to increase loafing areas for wintering gray-bellied brant (M. Davidson pers. comm.). If this occurs, these islands could be used by nesting terns in the spring and summer months when brant are absent. Jetty Island, an artificial dredge spoil island that parallels the Everett waterfront in northern Puget Sound was used unsuccessfully by a small number (<20) of nesting terns in the mid-1990s (R. Milner, pers. comm.). Extensive, habitat enhancement activities (e.g., removal of Scotch broom, area closures) could be implemented to create habitat for nesting terns.

Although the above sites have potential for tern management, WDFW does not support active management of sites in Washington that could serve as alternate nesting habitat for displaced terns. WDFW supports the goal of reducing tern predation on salmonid stocks in the Columbia River. However, they have concerns regarding possible impacts to salmon from the redistribution of terns to locations in Washington. Thus, although these sites were all historically colonized by terns and are in close proximity to the Columbia River estuary, we did not include these sites in our management alternatives. WDFW also stated that they would not oppose any colonization of terns in Washington if the terns were to recolonize a historic site or establish a new colony of their own accord. Thus, we have included the current nesting site at Dungeness NWR in our management alternatives.

The feasibility assessment identified three sites on the Oregon coast (in Coos Bay and the Umpqua River estuary) because they met all of the criteria described in Seto et al. (2003). These sites are islands that require moderate to extensive habitat enhancement. Fern Ridge Lake, near Eugene, was also identified as a site with potential for Caspian tern management if nesting habitat (island) can be created as proposed by the Corps in 2000. None of these sites are historical Caspian tern nesting sites and Oregon Department of Fish and Wildlife (ODFW) does not want to introduce "predation to other fish stocks that have never historically been subjected to Caspian tern predation (Klumph 2003)." ODFW "is committed to significantly reducing the potential impact of avian predators on Columbia River Basin stocks of salmon and steelhead." They acknowledge that the best way to accomplish this is to "disperse" the East Sand Island colony and manage colonies outside the estuary "at levels in balance with their local ecosystems and species communities." However, ODFW will not support managed relocation of Caspian terns to any site in Oregon other than historic sites (Klumph 2003). Thus, we did not include any sites on the Oregon Coast in our management alternatives. We did include Fern Ridge Lake in our analysis so that we may fully assess potential effects of nesting terns on ESA-listed salmonids found in the Willamette and McKenzie rivers. These rivers are within a 15 mile radius from Fern Ridge and may not serve as a primary food resource for the terns since a variety of resident fish species are present in the lake. Thus, although this is not a historic tern nesting site, relocation of terns to this site may not result in high levels of predation on other salmonid stocks.

California sites identified with potential for tern management are located in Humboldt Bay, San Francisco Bay, and the Sacramento Valley. See Chapter 3 for a description of sites located in San Francisco. Teal Island in the Humboldt Bay National Wildlife Refuge (NWR) was identified as a potential site for Caspian tern habitat management in the feasibility assessment. Since the 1960s, terns have nested on a small dredge spoil island (Sand Island) that was created in the late 1800s in northern Humboldt Bay. From the 1970s to 1990s, no terns were observed to nest in the bay, except for a report of 20 pairs in 1979 (Gill and Mewalt 1983). Terns returned to the site in 2001 and have continued to nest in low numbers through the present. Sand Island is small and limited in size. Teal Island is larger and could provide more nesting habitat for an increased number of terns in the bay. California Department of Fish and Game (CDFG, Morey 2004) and the Service's California/Nevada Operations (CNO) Office have expressed concerns about the impact of tern predation on ESA-listed salmonids and partnership efforts associated with salmon recovery in the Humboldt Bay area. Thus, CDFG

and CNO do not support the development of tern nesting habitat in the bay. Teal Island was eliminated from further consideration in this DEIS.

The scoping process and development of alternatives for this DEIS identified development of tern nesting habitat at the Yolo Bypass Wildlife Area and City of Davis Wetlands in the Sacramento Valley. Both of these sites are not historical Caspian tern nesting sites and CDFG expressed concerns for listed salmonids in the Sacramento River (Morey 2004). CDFG "supports Caspian Tern management in California only at historic colonies." Thus, although it appears that habitat could be developed for terns at these two sites in the Sacramento Valley, they were eliminated from further consideration in this DEIS.

2.5.3 Lethal Control of East Sand Island Tern Colony

Under this alternative, a lethal control program on terns would be the only management action implemented to reach and maintain a proposed range of nesting terns (2,500 to 3,125 nesting pairs) on East Sand Island. This proposed range was selected because this reduction was estimated to increase the population growth rate (λ) for Columbia River Basin steelhead by at least 1 percent (Table 2.2, NOAA Fisheries 2004, Appendix C). In order to achieve this proposed range of nesting pairs, up to 50 percent of breeding adult terns each year would be killed beginning in 2005. Based on the same population model used in Alternative A (see Chapter 4), this control program would need to kill a substantial number of terns (up to 10,000 terns in the first year, 5,000 to 8,000 terns in subsequent years) to reach the proposed range. The killing of such a large number of terns would be unacceptable to the Service as it would be contrary to the conservation of this species. In addition, it is anticipated that a lethal control program of this magnitude would not be acceptable to the public.

2.5.4 Reduction of Caspian Tern Nesting Habitat on East Sand Island and No Active Facilitation to Other Sites within the Region

This alternative would reduce the tern nesting habitat on East Sand Island to approximately 1 to 1.5 acres, but there would be no active management of potential nesting sites to redistribute the nesting population of terns within the Pacific Coast region. Displaced terns would need to utilize existing habitat elsewhere in the region (see Appendix F for a list of existing nesting habitat currently available to terns in the Pacific Coast region). Displaced terns would nest at these locations, establish new colonies elsewhere, or continue to nest or feed in the estuary. This alternative was not considered in detail because of the uncertainties with respect to success of achieving the proposed range of nesting pairs, or where displaced terns would go to nest. For example, terns may nest at other Columbia River sites, resulting in no reduction in effects of tern predation on Columbia River salmonids. Additionally, management at alternate sites is expected to influence where displaced terns would nest (e.g, sites that would have minimal conflicts with ESA-listed salmonids). Lastly, plaintiffs of the 2000 lawsuit (see Chapter 1) wanted to ensure that suitable nesting habitat was established in the region prior to reduction in colony size on East Sand Island. This alternative would not ensure suitable habitat was available to terns in the region.

2.6 Comparison of Alternatives

Table 2.3 summarizes and compares the alternative components of the four alternatives described above and associated anticipated effects.

TABLE 2.3. Comparison of Caspian Tern Management EIS Alternatives by component and associated anticipated effects.

ALTERNATIVE COMPONENTS				
	ALTERNATIVE A No Action-Current Management Program	**ALTERNATIVE B** No Management	**ALTERNATIVE C** Redistribution of ESI Tern Colony **PREFERRED ALTERNATIVE**	**ALTERNATIVE D** Redistribution and Lethal Control of ESI Tern Colony
East Sand Island (ESI) Habitat Management	Annually maintain 6 acres of open sand habitat	No preparation of nesting habitat	Reduce nesting habitat on ESI to approximately 1 acre	Same as Alternative C
Habitat Management to Facilitate Redistribution	No	No	Yes; manage potential nesting sites in the region	Same as Alternative C
Tern Control Program	No	No	No	Yes, removal of adults, if necessary, to obtain target colony size of 2,500 to 3,125 breeding pairs
ANTICIPATED EFFECTS				
Regional Tern Population	Maintain current increasing trend	Stabilized or declining trend	Initial decrease but overall stabilization of population	Same as Alternative C, except if lethal control is implemented; then population anticipated to decline
East Sand Island Tern Colony	Maintain current increasing trend until nesting habitat is maximized by 2009	Loss of colony on East Sand Island and entire Columbia River estuary	Colony size range between 2,500 and 3,125 breeding pairs	Same as Alternative C
Columbia River ESA-listed salmonids	Continued/anticipated increase in juvenile smolt consumption; no improvement in population growth rate of ESA-listed salmonids	Elimination of juvenile smolt consumption; anticipate increase in population growth of ESA-listed salmonids	Substantial reduction in juvenile smolt consumption; anticipate increase in population growth of ESA-listed salmonids	Same as Alternative C
ESTIMATED COSTS [a]				
Habitat Management	$ 30,000	$0	$ 2,422,093 (first year costs, includes construction, habitat enhancement, predator management, and social attraction costs at all sites)	$ 2,422,093 (first year costs, includes construction, habitat enhancement, predator management, social attraction costs at all sites); $ 65,400 for lethal control, if implemented
Short- term Monitoring	$ 165,000	$0	$ 269,000/YR	$ 269,000/YR
Long-term Monitoring	$ 5,000	$0	$ 100,000 (baseline regional monitoring – first year and every 10 years) $ 10,000 (annual colony monitoring)	$ 100,000 (baseline regional monitoring – first year and every 10 years) $ 10,000 (annual colony monitoring)

[a] Detailed estimated costs for each proposed alternative site are located in Appendix G.